



National Transportation Safety Board

**Office of Aviation Safety
Washington, D.C. 20594-2000**

January 30, 2014

**WEATHER STUDY
CEN14FA110**

A. Accident

Location: Waterford, MI

Date: January 10, 2014

Time: 1948 eastern standard time (0048 UTC¹ on January 11, 2014)

Aircraft: Cessna 310R, registration: N3829G

B. Meteorological Specialist

Mike Richards

Senior Meteorologist

National Transportation Safety Board

Operational Factors Division, AS-30

Washington, DC 20594-2000

C. Details of the Investigation

The National Transportation Safety Board's (NTSB) meteorological specialist was not on scene and gathered weather data for this investigation from the NTSB's Washington D.C. office. All times are in eastern standard time (EST) on January 10, 2014 - based upon the 24-hour clock. Directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl), unless otherwise noted.

Coordinates used for the accident location: 42.6646° North latitude, 83.4394° West longitude.

¹ UTC – abbreviation for Coordinated Universal Time

Synoptic Conditions

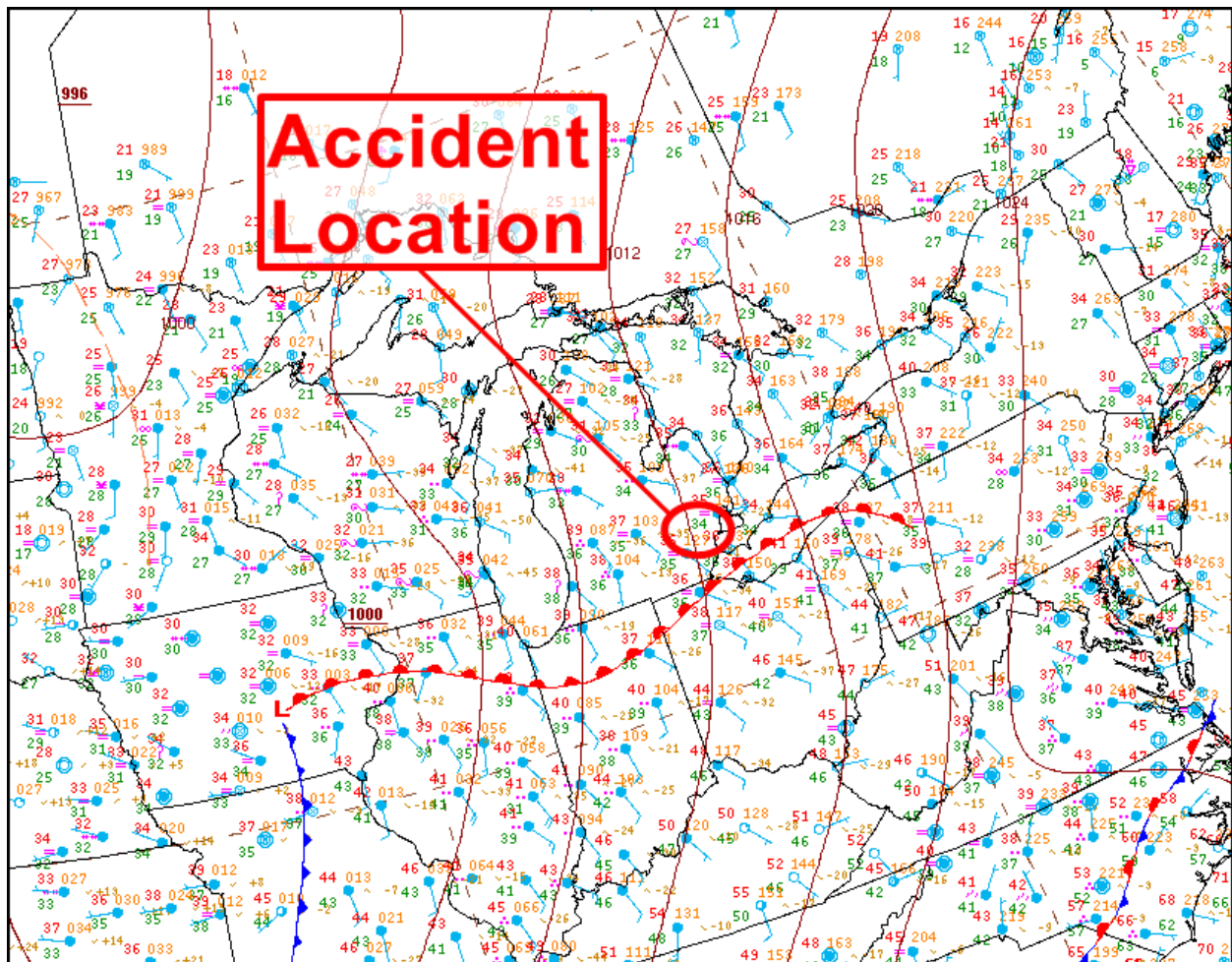


Figure 1 – NWS Surface Analysis Chart for 1900 EST.

The National Weather Service (NWS) Surface Analysis Chart for 1900 EST (figure 1) depicted a low-pressure center in Iowa, with a warm front extending eastward from this low-pressure center through Lake Erie and into northwestern Pennsylvania. The surface wind throughout the accident region was generally from the southeast at a magnitude near 10 knots or less. Overcast skies prevailed with many station models indicating mist or rain along and ahead of the warm front.

A regional Next-Generation Radar (NEXRAD) mosaic (figure 2) obtained from the National Climatic Data Center (NCDC) for 1945 EST showed much of the western Great Lakes region, including the majority of Michigan, Wisconsin, northeast Illinois and northern Indiana, under light to moderate values of reflectivity. The accident location was on the eastern edge of this large area of reflectivity.

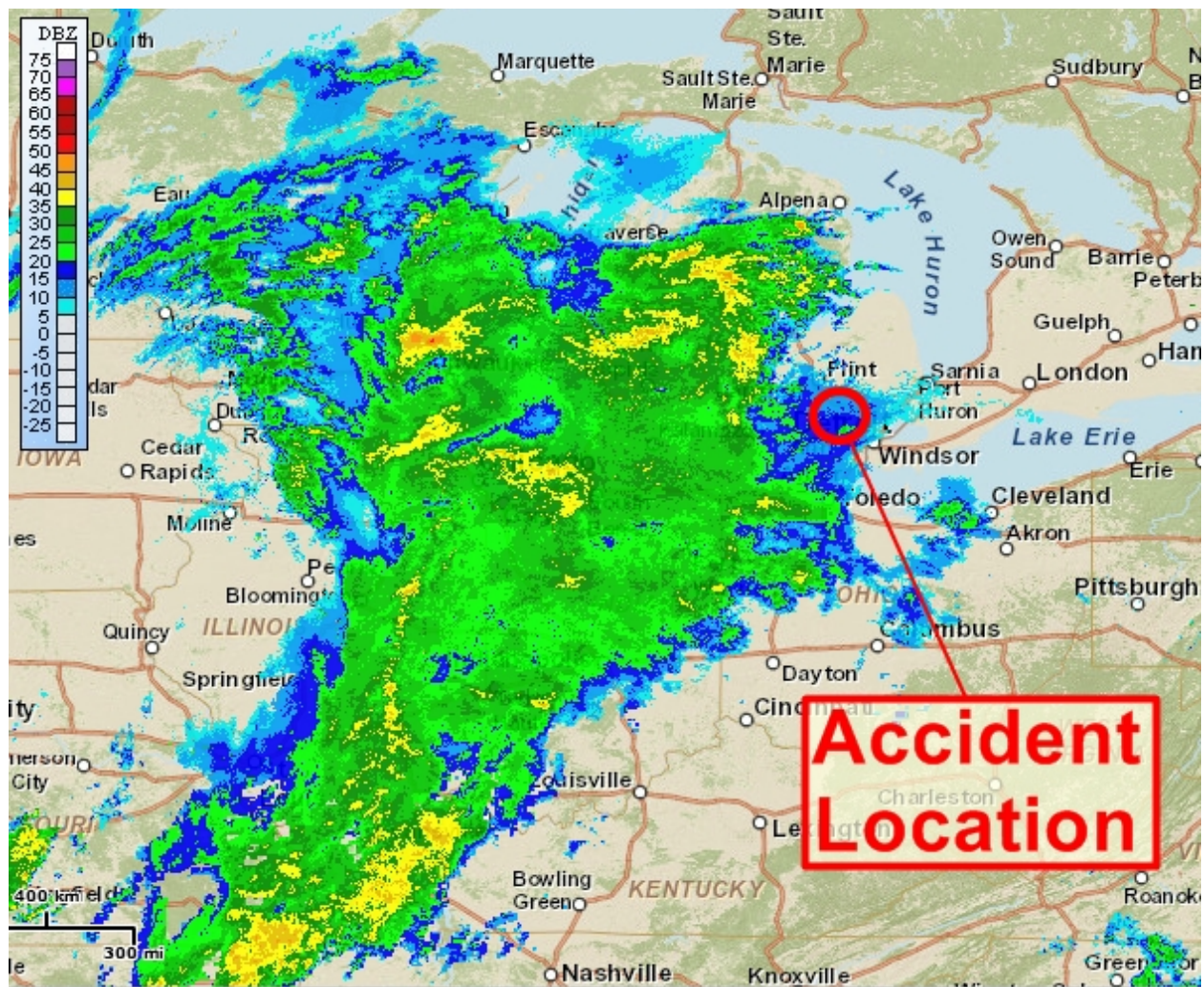


Figure 2 – NCDC NEXRAD mosaic from 1945 EST.

Surface Observations

Oakland County International Airport (KPTK) in Pontiac, Michigan, was located within one mile to the east of the accident site at an elevation of 981 feet. The following reports were issued from KPTK during the time period surrounding the accident time:

- [1753 EST] METAR KPTK 102253Z 15007KT 3/4SM R09R/5500VP6000FT BR VV002 01/01 A2991 RMK AO2 SLP140 T00110006
- [1853 EST] METAR KPTK 102353Z 15006KT 1/2SM R09R/3000V3500FT FG VV002 02/01 A2988 RMK AO2 SLP127 4/013 T00170011 10017 20006 58028
- [1929 EST] SPECI KPTK 110029Z 15010KT 1/4SM R09R/2000V2800FT FG VV002 02/01 A2986 RMK AO2
- [1953 EST] METAR KPTK 110053Z 14009KT 1/4SM R09R/2000V2600FT FG VV002 02/02 A2985 RMK AO2 SLP117 T00170017
- [2005 EST] SPECI KPTK 110105Z 15009KT 1/2SM R09R/2000V2400FT -RA FG VV002 02/02 A2984 RMK AO2 RAB0057 P0000

At 1929 EST, KPTK reported a wind from 150° at 10 knots, visibility of one-quarter statute mile, runway visual range (RVR) on runway 09R variable between 2,000 and 2,800 feet, fog, vertical visibility 200 feet, temperature of 2° Celsius (C) and dew point temperature of 1°C, altimeter setting 29.86 inches of mercury. Remarks: station with a precipitation discriminator.

At 1953 EST, KPTK reported a wind from 140° at 9 knots, visibility of one-quarter statute mile, RVR on runway 09R variable between 2,000 and 2,600 feet, fog, vertical visibility 200 feet, temperature of 2°C and dew point temperature of 2°C, altimeter setting 29.85 inches of mercury. Remarks: station with a precipitation discriminator, sea-level pressure 1011.7 hectopascals (hPa), hourly temperature of 1.7°C and hourly dew point temperature of 1.7°C.

One-minute data from the Automated Surface Observing System (ASOS) at KPTK was retrieved for the times surrounding the accident. Wind magnitudes are in knots and RVR is in feet for runway 09.

<u>Time</u>	<u>Avg-W Dir</u>	<u>Avg-W Spd</u>	<u>W-Gust Dir</u>	<u>W-Gust Mag</u>	<u>RVR</u>
1930	151	8	152	10	2000
1931	149	7	152	10	1800
1932	149	8	143	11	2000
1933	144	8	138	11	2200
1934	145	9	139	10	2000
1935	147	9	145	10	2000
1936	148	9	154	11	2000
1937	144	8	151	8	2000
1938	141	6	139	8	2000
1939	141	7	149	10	2000
1940	140	8	145	10	2000
1941	140	8	155	10	2000
1942	143	8	146	10	2000
1943	143	8	137	9	2000
1944	136	7	125	8	2000
1945	135	7	141	9	2000
1946	141	7	141	7	2000
1947	146	7	148	10	2000
1948	146	7	145	7	2000
1949	143	6	156	9	2000
1950	142	7	138	9	2000
1951	139	7	143	8	2600
1952	138	7	143	9	2000
1953	138	9	136	11	2400
1954	140	9	135	10	2200
1955	143	8	149	11	2200

Terminal Aerodrome Forecasts

A Terminal Aerodrome Forecasts (TAF)² issued at 1534 EST for KPTK forecasted for the accident time: a wind from 160° at 14 knots, visibility of 2 statute miles, light rain, mist, overcast cloud base at 400 feet above ground level (agl), wind shear with wind at 2,000 feet agl from 190° at 45 knots.

TAF AMD KPTK 102034Z 1021/1118 15010KT 2SM BR OVC004
FM110000 16014KT 2SM -RA BR OVC004 WS020/19045KT
TEMPO 1106/1110 2SM RA BR OVC004
FM111200 18010KT 2SM SHRA BR OVC004
FM111700 24012G20KT 6SM BR OVC010=

A TAF issued at 1822 EST for KPTK forecasted for the accident time: a wind from 150° at 10 knots, visibility of 2 statute miles, mist, overcast cloud base at 400 feet agl, wind shear with wind at 2,000 feet agl from 190° at 45 knots; temporary conditions³ between 1900 and 2300 EST: visibility three-quarters of a statute mile, light rain showers, mist, ceiling broken at 200 feet agl.

TAF KPTK 102322Z **1100/1124 15010KT 2SM BR OVC004 WS020/19045KT**
TEMPO 1100/1104 3/4SM -SHRA BR BKN002
FM110400 16014KT 2SM -RA BR OVC004 WS020/19045KT
TEMPO 1106/1110 1SM RA BR OVC002
FM111200 18010KT 2SM SHRA BR OVC004
FM111700 24012G20KT 6SM BR OVC010=

Sounding Data

Atmospheric data were retrieved from a rawinsonde launch for 1900 EST from the Detroit/Pontiac, Michigan, NWS office (rawinsonde station: DTX), which was located approximately 2 miles north of the accident site. These data are presented in figure 3.

The DTX sounding indicated the majority of the lower troposphere was stable or conditionally unstable. The majority of the atmosphere below 5,000 feet was characterized by several temperature inversions. The relative humidity was greater than 97 percent below 8,000 feet. The freezing level was approximately 7,500 feet. Assessments of icing made by the Universal RAwinsonde OBservation program (RAOB) for this sounding yielded no potential for icing below 8,000 feet.

The DTW sounding identified a southeast wind of 9 knots near the surface, with a southerly wind of 32 knots at about 2,000 feet. Above this level the wind *veered*⁴ slightly to a southwesterly wind near 5,000 feet. Above this level the wind remained southwesterly and below 50 knots through 17,000 feet. Calculations by RAOB indicated the potential for

² Conditions forecasted in the TAF are only official for 5 statute miles from the forecast site.

³ Greater than 50% probability of temporary fluctuations in forecast meteorological conditions which are expected to last less than one hour in each instance and, in the aggregate, to cover less than half of the indicated period. The period of time covered by a TEMPO group should be the minimum necessary, not to exceed 4 hours. Use TEMPO groups for high probability (greater than 50%) expectations only.

⁴ A veering wind is a wind that turns clockwise with increasing height.

significant turbulence and “light” low-level wind shear (LLWS) in about the lowest 1,000 feet of this atmosphere.

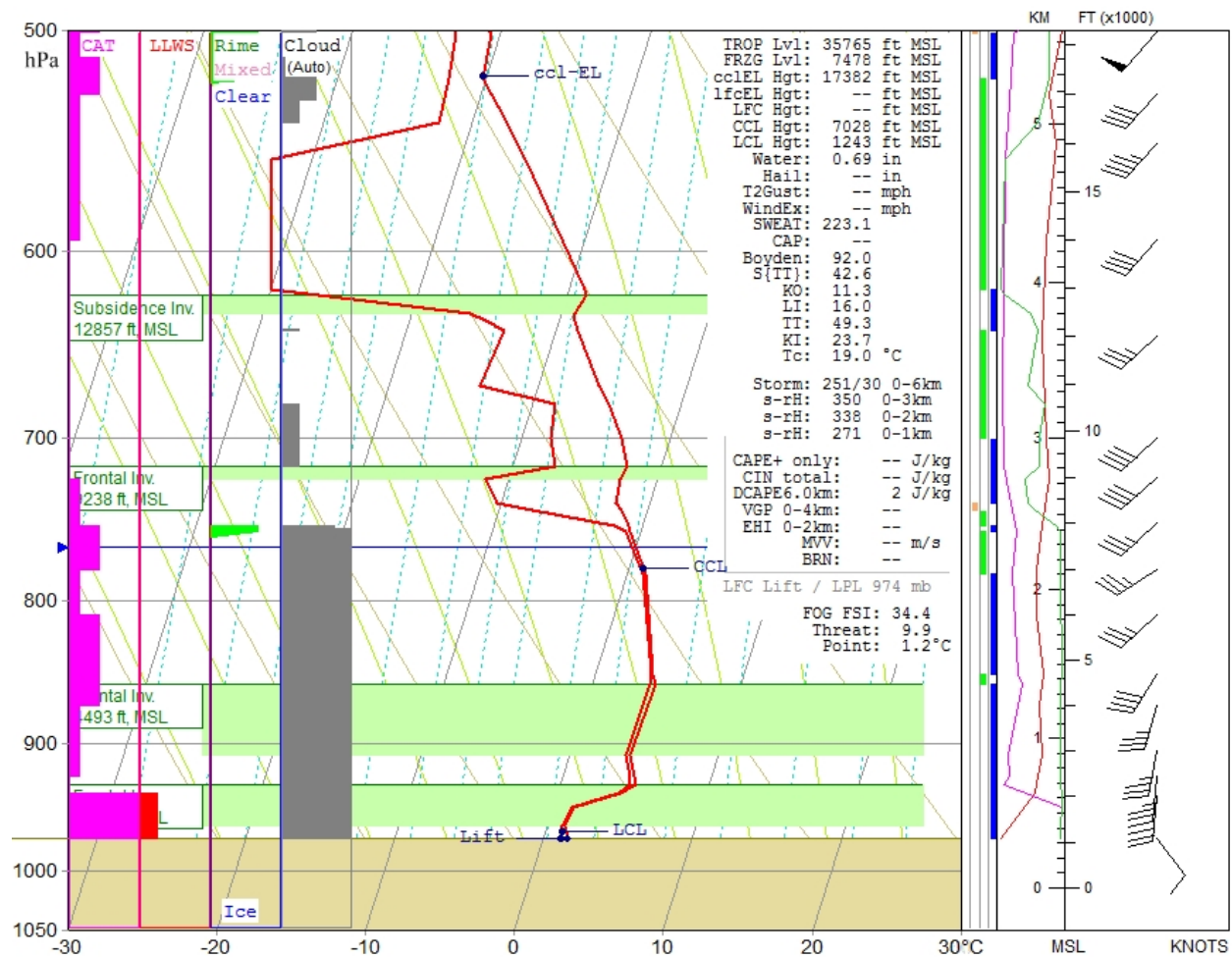


Figure 3 – Rawinsonde sounding from DTX in SkewT/LogP format for 1900 EST, surface to 500 hPa.

Aircraft Data

Meteorological data below about 10,000 feet from four AMDAR-reporting⁵ aircraft arriving/departing Detroit Metropolitan Wayne County Airport (located about 27 miles south of the accident site) within about forty five minutes of the accident time is presented here. Altitude is pressure altitude in feet⁶, wind speed is in knots and temperature is in degrees Celsius.

These four aircraft all reported southerly wind magnitudes of 34 knots or greater at altitudes at or immediately above 2,000 feet, as well as above-freezing temperatures below about 7,000 feet.

⁵ AMDAR is the generally-accepted worldwide term for automated weather reports from commercial aircraft.

⁶ These altitudes are calculated from the aircraft's static pressure according to the International Standard Atmosphere regardless of altitude (1013.25 hPa is always surface pressure). This can cause some error, including negative altitudes, particularly at low altitudes.

<u>Time</u>	<u>Latitude/Longitude</u>	<u>Altitude</u>	<u>W-Dir</u>	<u>W-Spd</u>	<u>Temp</u>
1957	42.649/-83.620	9500	193°	42	-4.8°
1958	42.549/-83.570	8000	207°	35	-1.9°
1959	42.479/-83.520	6500	203°	39	1.1°
2003	42.549/-83.258	5000	207°	34	4.8°
2008	42.339/-83.278	3500	190°	29	6.8°
2010	42.279/-83.328	2000	187°	37	8.1°

<u>Time</u>	<u>Latitude/Longitude</u>	<u>Altitude</u>	<u>W-Dir</u>	<u>W-Spd</u>	<u>Temp</u>
1957	42.209/-83.363	700	142°	3	3.1°
1957	42.219/-83.363	700	145°	7	3.0°
1957	42.219/-83.363	710	164°	5	2.8°
1957	42.219/-83.363	710	170°	6	4.0°
1958	42.209/-83.373	790	146°	9	2.8°
1958	42.199/-83.373	990	152°	12	2.5°
1958	42.199/-83.373	1280	153°	19	2.1°
1958	42.199/-83.383	1550	165°	23	2.0°
1958	42.189/-83.383	1920	177°	33	4.3°
1958	42.189/-83.393	2320	190°	35	7.2°
1958	42.179/-83.393	2630	191°	34	7.6°
1958	42.179/-83.393	2920	193°	31	7.2°
1958	42.179/-83.403	3180	190°	30	6.8°
1958	42.169/-83.403	3400	189°	29	6.3°
1959	42.169/-83.413	3630	191°	28	6.0°
1959	42.159/-83.413	3890	190°	28	5.6°
1959	42.129/-83.443	6080	207°	35	1.7°
2000	42.099/-83.473	8170	187°	42	-2.8°

<u>Time</u>	<u>Latitude/Longitude</u>	<u>Altitude</u>	<u>W-Dir</u>	<u>W-Spd</u>	<u>Temp</u>
2010	42.220/-83.363	800	172°	5	2.3°
2011	42.190/-83.383	2300	187°	34	8.1°
2012	42.160/-83.443	3800	194°	30	6.3°
2012	42.160/-83.493	5300	205°	31	3.3°
2013	42.180/-83.533	6800	192°	39	0.1°
2013	42.210/-83.573	8300	195°	37	-2.3°

<u>Time</u>	<u>Latitude/Longitude</u>	<u>Altitude</u>	<u>W-Dir</u>	<u>W-Spd</u>	<u>Temp</u>
2023	42.339/-83.131	9400	190°	46	-4.3°
2025	42.419/-83.071	7900	197°	37	-0.9°
2026	42.469/-83.091	6400	203°	39	1.6°
2028	42.399/-83.201	4900	203°	36	4.3°
2030	42.339/-83.251	3400	193°	36	6.3°
2032	42.269/-83.301	1900	184°	38	5.8°

Pilot Reports

There was one publically disseminated pilot report⁷ made within about two hours of the accident time and about 50 miles of the accident location:

FNT UA /OV FNT /TM 0046 /FLUNKN /TP E135 /SK OVC037-TOP040/OVC070
/RM DURC DEP RY9=

Weather Radar

Terminal Doppler Weather Radar (TDWR) data from Detroit, Michigan (TDTW), is presented in figures 4-5. TDTW was located approximately 32 miles south of the accident site. Assuming standard refraction and considering the $\sim 0.5^\circ$ beam width⁸ for the TDWR beam, the TDTW 0.10° tilt would have “seen” altitudes between about 950 and 2,650 feet above msl at the accident site.

Figure 4 depicts light reflectivity values of 5-10 dBZ through much of the accident aircraft’s final positions. Velocity measurements from TDTW (figure 5) indicate a wind component away from the radar near 40 knots along the final portion of the accident aircraft’s flight path.

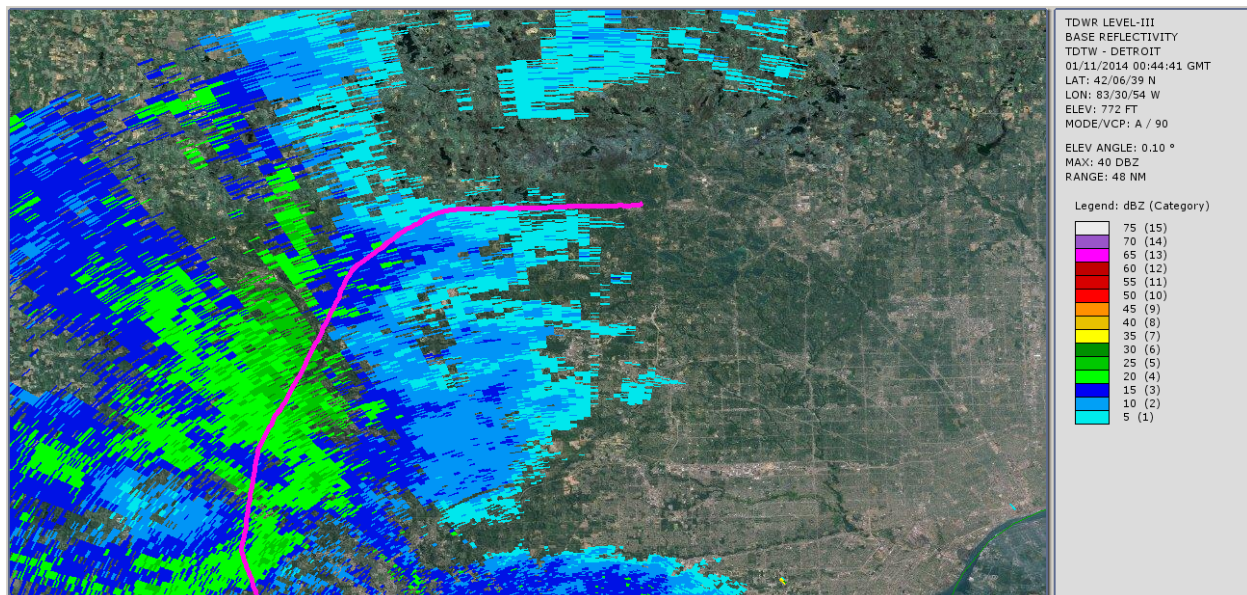


Figure 4 – TDTW 0.10° reflectivity product from 1944 EST. Accident aircraft’s flight path (headed north then east) indicated by pink line.

⁷ Only pilot reports distributed with the UBMI** headers were considered.

⁸ Beam width - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

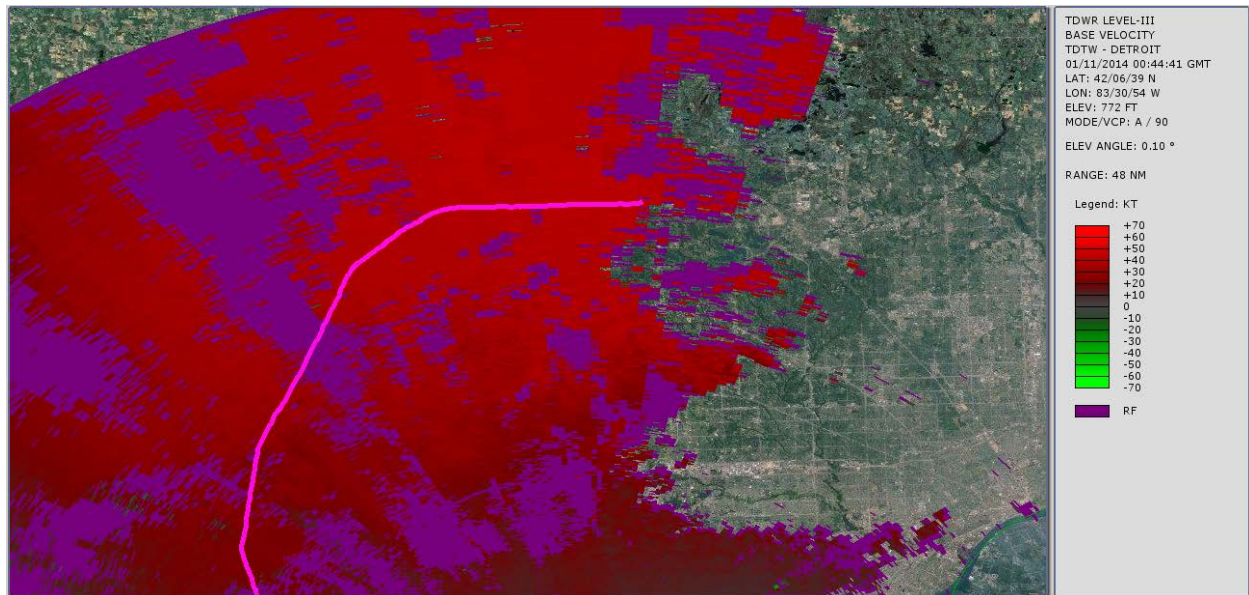


Figure 5 – TDTW 0.10° velocity product from 1944 EST. Accident aircraft's flight path (headed north then east) indicated by pink line.

Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-13 10.7 μ m (infrared) data were obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man computer Interactive Data Access System (McIDAS). Imagery from 1945 EST is presented in figure 6. The GOES-13 infrared imagery identified cloudy conditions across the majority of the region. Cloud-top temperatures in the vicinity of the accident location were -47°C. When considering the DTX rawinsonde data (but not shown in figure 3), these temperatures corresponded to heights of approximately 29,500 feet. It should be noted that all satellite data presented here have not been corrected for any parallax error.

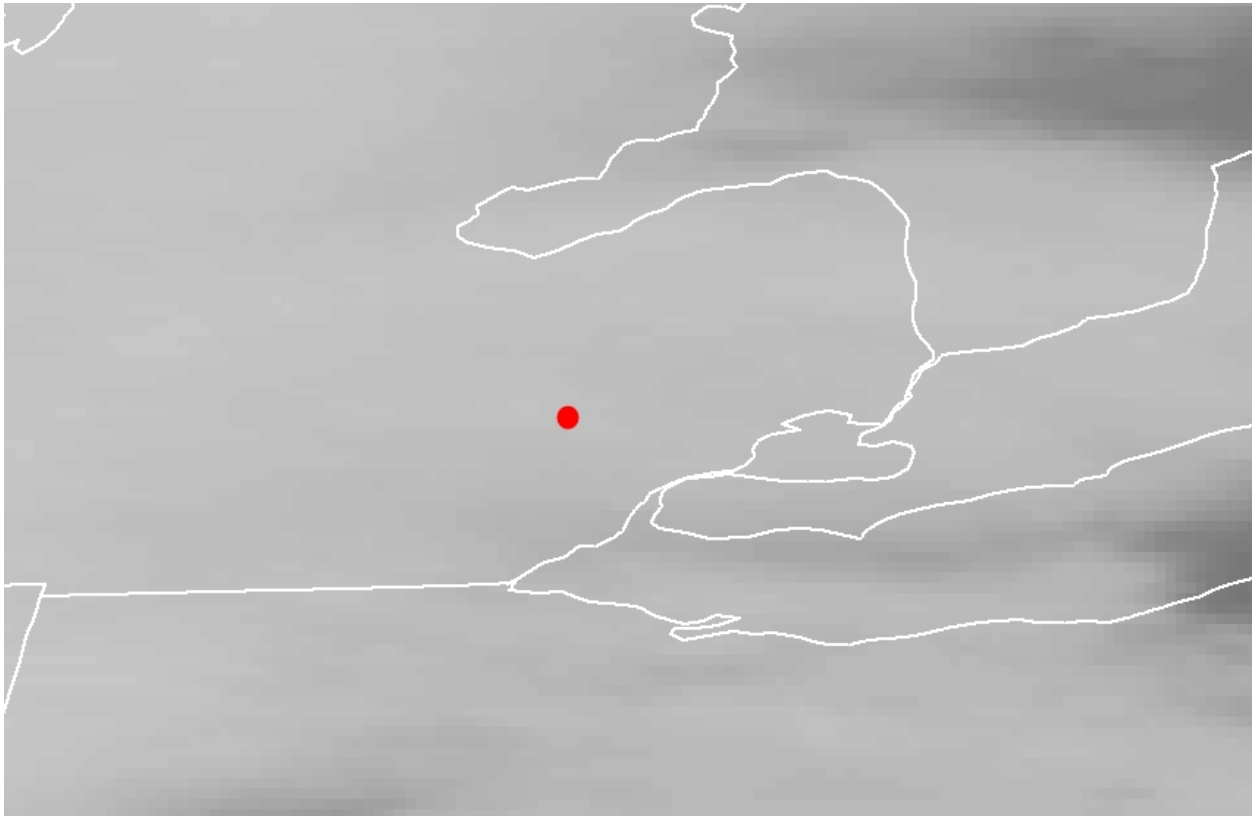


Figure 6 – GOES-13 10.7 μ m (infrared) imagery from 1945 EST. Red dot denotes accident location.

Lightning

Total lightning data from the Earth Networks Total Lightning Network did not identify the presence of any lightning in the accident area at the accident time.

Area Forecast

An Area Forecast that included Michigan was issued at 1445 EST. The portion of the Area Forecast directed toward the southern half of lower Michigan forecasted for the accident time: overcast cloud base at 2,000 feet above msl with cloud tops to 8,000 feet above msl, visibility of 3 statute miles, light rain, mist.

FAUS43 KPCI 101945

FA3W

_CHIC FA 101945

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 111400

CLDS/WX VALID UNTIL 110800...OTLK VALID 110800-111400

ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY

.

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.

TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.

.
SYNOPSIS...LOW PRES SERN NE WITH WRMFNT SWRN MO-SRN IL-ERN
KY. CDFNT SERN KS-SWRN OK-SWRN TX. TROF ERN SD TO N CNTRL NE.
06Z LOW PRES NERN WI WITH WRMFNT TO NERN IN. CDFNT SRN LM-
WRN KY-NWRN MS-NWRN LA-SRN TX. 14Z CDFNT ERN KY-SERN LS-SRN
TX.

.
LM LWR MI LH
N HLF...OVC020 TOP 060. VIS 3SM -FZDZ BR. 03Z VIS 3SM -RA BR.
OTLK...IFR CIG RA BR 13Z FZDZSN.
S HLF...OVC020 TOP 080. VIS 3SM -RA BR. OTLK...IFR CIG RA BR.

Aviation Section of the Area Forecast Discussion

An Area Forecast Discussion (AFD) was issued at 1809 EST by the National Weather Service Weather Forecast Office for Detroit/Pontiac, Michigan (KDTX). The aviation portion of the AFD is presented here.

FXUS63 KDTX 102309
AFDDTX
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE DETROIT/PONTIAC MI
609 PM EST FRI JAN 10 2014

.AVIATION...

//DISCUSSION...

PLENTY OF AVIATION CONCERNS TO WORRY ABOUT FOR THIS TAF CYCLE. ALTHOUGH THE DENSE FOG HAS NOT REALLY AFFECTED THE AVIATION SITES...CONDITIONS HAVE SETTLED DOWN TO IFR. UPSTREAM OBSERVATIONS INDICATE AN AREA OF RAIN OVER WESTERN MICHIGAN HEADING EAST DURING THE EVENING HOURS. HI-RES MODEL RUNS BRING THE RAIN IN THIS EVENING...LOWERING CONDITIONS TO LIFR AT TIMES. TEMPERATURES SHOULD BE WARM ENOUGH THAT PRECIP WILL BE ALL RAIN. THE ONLY QUESTION IS MBS...HOWEVER MODEL SOUNDINGS CONTINUE TO INDICATE ENOUGH WARM AIR IN THE LOW LEVELS FOR THE PRECIPITATION TYPE TO REMAIN AS ALL RAIN AT MBS. MODEL SOUNDINGS CONTINUE TO INDICATE THE POTENTIAL FOR LOW LEVEL WIND SHEAR FROM 00Z TO 12Z SATURDAY AS SOUTHERLY FLOW INCREASES AHEAD OF THE COLD FRONT. COLD FRONT IS EXPECTED TO MOVE THROUGH BETWEEN 17Z AND 21Z SATURDAY. THERE WILL BE POTENTIAL FOR LIGHT PRECIP EVEN AFTER THE PASSAGE OF THE COLD FRONT...IF THIS IS THE CASE TEMPERATURES ARE EXPECTED TO DROP BELOW FREEZING MEANING ANY LINGERING SHOWERS WILL CHANGE OVER TO SNOW. FOR DTW...THE BEST CHANCE FOR HEAVIEST PRECIP IS EXPECTED TO BE IN THE 03Z TO 09Z TIMEFRAME. LOW LEVEL WIND SHEAR IS ALSO EXPECTED TONIGHT AS SOUTHERLY FLOW INCREASES.

//DTW THRESHOLD THREATS...

* HIGH CONFIDENCE IN CEILINGS BELOW 5KFT THROUGH THE TAF PERIOD.

* LOW CONFIDENCE IN VISIBILITIES FALLING BELOW 1/2 SM AND CEILINGS

FALLING BELOW 200 FT.

* HIGH CONFIDENCE IN PRECIP BEGIN ALL RAIN THROUGH SATURDAY MORNING.

AIRMETs

Airmen's Meteorological Information (AIRMET) advisories issued for Michigan and active for the accident time are presented here (also see Figure 7).

An AIRMET for moderate ice for altitudes between 7,000 feet and FL180⁹ was issued at 1545 EST for a region that included the accident location. An AIRMET for moderate ice for altitudes below 16,000 feet was issued at 1545 EST for a region that did not include the accident location.

WAUS43 KPCI 102045

WA3Z

_CHIZ WA 102045

AIRMET ZULU UPDT 5 FOR ICE AND FRZLVL VALID UNTIL 110300

.

AIRMET ICE...IA MO WI LM MI LH IL IN KY

FROM SSM TO YVV TO 30SE ECK TO FWA TO CVG TO HNN TO LOZ TO 50ESE BWG TO 20W RZC TO 40E DSM TO 20E DBQ TO 30W GRB TO SSM
MOD ICE BTN 070 AND FL180. CONDS CONTG BYD 03Z THRU 09Z.

.

AIRMET ICE...ND SD NE KS MN IA MO WI LM LS MI LH IL

FROM 30N INL TO YQT TO SSM TO 30W GRB TO 20E DBQ TO 20SSW DSM
TO 30SSE SLN TO 30E MCK TO 20NNW LBF TO 30N INL
MOD ICE BLW 160. CONDS CONTG BYD 03Z THRU 09Z.

An AIRMET for IFR¹⁰ conditions was issued at 1545 EST for a region that included the accident location.

WAUS43 KPCI 102045

WA3S

_CHIS WA 102045

AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 110300

.

AIRMET IFR...ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY

⁹ Flight Level (FL) - standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard atmosphere using 1013.25 hPa (29.92 in Hg) for surface pressure.

¹⁰ Instrument Flight Rules – ceiling 500 feet agl to below 1,000 feet agl and/or visibility 1 statute miles to less than 3 statute miles

FROM 40S YWG TO 40WSW YQT TO 60NW RHI TO SSM TO YVV TO 40SSE
ECK TO FWA TO CVG TO 30SW LOZ TO RZC TO OSW TO 40SE ICT TO 60W
PWE TO 60ESE OBH TO 40S YWG
CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS CONTG BYD 03Z THRU
09Z.

An AIRMET for moderate turbulence for altitudes between FL220 and FL380 was issued at 1545 EST for a region that did not include the accident location.

WAUS43 KPCI 102045
WA3T
_CHIT WA 102045
AIRMET TANGO UPDT 3 FOR TURB VALID UNTIL 110300
.
AIRMET TURB...MN IA WI LM LS MI LH IL
FROM 80W YQT TO SSM TO ORD TO 40NNW MCW TO 80W YQT
MOD TURB BTN FL200 AND FL380. CONDS DVLPG 21-00Z. CONDS CONTG
BYD 03Z ENDG 03-06Z.

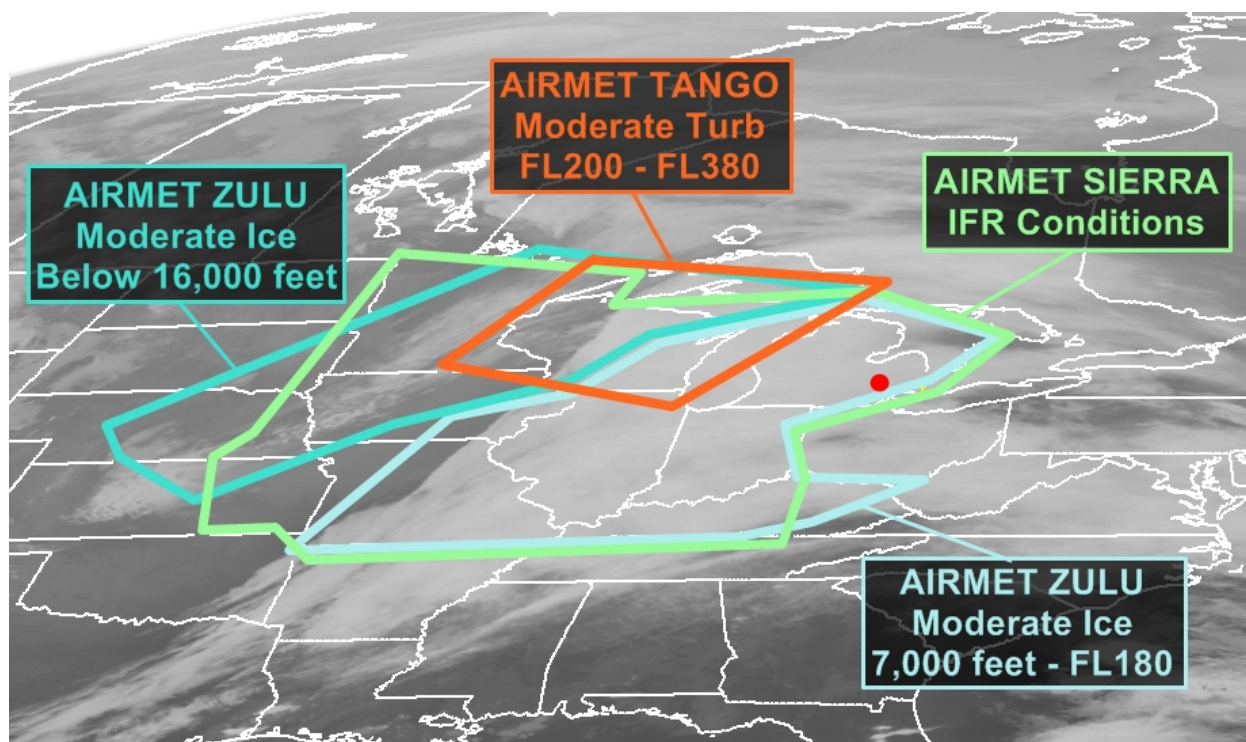


Figure 7 – Graphical depiction of AIRMET boundaries presented in this section. Products overlaid onto GOES-13 10.7µm image from 1945 EST. Red dot denotes accident location.

SIGMETs

There were no convective or non-convective Significant Meteorological Information (SIGMET) advisories active for the accident location at the accident time.

CWSU Products

There were no Center Weather Advisories issued by the Center Weather Service Unit (CWSU) at the Cleveland Air Route Traffic Control Center (ZOB) that were active for the accident location at the accident time.

At 1334 EST, the CWSU at ZOB issued the following Meteorological Impact Statement, which advised air traffic control of widespread IFR conditions for a region that included the accident location, with these conditions continuing through 2100 EST.

FAUS20 KZOB 101834
ZOB MIS 02 VALID 101834-110200
...FOR ATC PLANNING PURPOSES ONLY...
ENTIRE ZOB AIRSPACE EXCEPT NE 1/4...WDSPRD IFR CIG/VIS BR/FG. IFR
WILL CONTINUE THRU 02Z.

Weather Briefing

Attachment 1 to this report catalogues weather briefing services provided to N3829G by CSC DUATS on January 10, 2014. Attachment 2 to this report provides weather briefing information retrieved by the accident aircraft from *FltPlan.com*.

Astronomical Data

The astronomical data obtained from the United States Naval Observatory for 42.7° North latitude and 83.4° West longitude, indicated the following:

SUN		
Sunset		1720 EST
End civil twilight		1751 EST
MOON		
Moonrise		1325 EST
Moonset		0405 EST (on January 11, 2014)

Additional Information

Attachment 3 to this report provides surface airport observations and TAFs surrounding the alternate airport for the accident flight, as well as surface airport observations for a number of previous flights flown by the accident pilot (retrieved from the pilot's log that may be found in the NTSB's docket for this accident).

*Submitted by: Mike Richards
NTSB, AS-30*